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## MYOCARDIAL REVASCULARIZATION IN ACUTE CORONARY SYNDROME IN UDMURT REPUBLIC

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*The urgency of the investigated problem is caused by high mortality from cardiovascular diseases. The aim of the study is to evaluate the results of myocardial revascularization in acute coronary syndrome. In the study of this problem, theoretical and empirical methods are applied: analysis of literature, study and generalization of innovative medical experience, analysis, synthesis, observation.*

**Materials and methods.** *We studied retrospectively 125 case histories of patients who entered the Republican Clinical Diagnostic Center in 2015 with the diagnosis of acute coronary syndrome (ACS) for percutaneous coronary intervention (PCI) and treated in the department of acute myocardial infarction No.1. All patients underwent PCI. These patients have a stent in the coronary artery. The 95 patients were admitted to the control echocardiography 1.8–2 years after PCI. The data was analyzed using the Microsoft Excel program.*

**Results.** *Basically there is a rescue or prepared PCI in our republic. In 77% of patients, the pathological wave Q / QS was formed at the time of admission. The left ventricle ejection fraction was higher and the number of nonfunctional zones of myocardium was lower in patients who had undergone PCI later. The echocardiography results are improving with an increase of the time from onset of the disease to percutaneous coronary interventions.*

**Conclusions.** *It is shown that at the time of reoxygenation the formation of reactive oxygen species sharply increases and can damage the cell. This article can be useful for cardiologists, intervention surgeons, therapists, medical students, interns, postgraduate students.*

**Keywords:** *ischemic heart disease; acute coronary syndrome; myocardial infarction; unstable angina; percutaneous coronary interventions; lipid per-oxidation.*

## РЕВАСКУЛЯРИЗАЦИЯ МИОКАРДА ПРИ ОСТРОМ КОРОНАРНОМ СИНДРОМЕ В УДМУРТСКОЙ РЕСПУБЛИКЕ

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*Актуальность изучаемой проблемы обусловлена высокой смертностью от сердечно-сосудистых заболеваний. Целью работы является оценка результатов реваскуляризации миокарда при остром коронарном синдроме.*

**Материалы и методы.** Ретроспективно было изучено 125 историй болезни пациентов, поступивших с острым коронарным синдромом в отделение острого инфаркта миокарда №1 БУЗ УР «Республиканского клинико-диагностического центра МЗ УР». Всем пациентам проведено чрескожное коронарное вмешательство (ЧКВ), установлен стент в коронарную артерию. 95 пациентам была проведена контрольная эхокардиография спустя 1,8–2 года после ЧКВ. Данные были проанализированы при помощи программы Microsoft Excel.

**Результаты.** В основном в Удмуртии в 2015 году проводилось спасительное или отсроченное ЧКВ. У 77% пациентов к моменту поступления сформировался патологический зубец Q/QS. Фракция выброса больше, количество афункциональных зон меньше у пациентов с большим временем от начала клиники до ЧКВ.

**Выводы.** Это говорит о том, что возможно во время реоксигенации активируется перекисное окисление липидов и свободные радикалы повреждают клетки. Данная статья может быть полезна врачам-кардиологам, терапевтам, интервенционным хирургам, ординаторам, аспирантам.

**Ключевые слова:** ишемическая болезнь сердца; острый коронарный синдром; инфаркт миокарда; нестабильная стенокардия; чрескожное коронарное вмешательство; перекисное окисление липидов.

### 1. Introduction

#### 1.1. Relevance

Ischemic heart disease (IHD) is a socially significant disease. IHD is characterized by a high prevalence among the population, a recurring course of the disease, repeated and prolonged inpatient treatment. Exacerbation of IHD is an acute coronary syndrome. Acute coronary syndrome (ACS) is one of the most frequent causes of hospitalization of patients.

## **1.2. Literature Review**

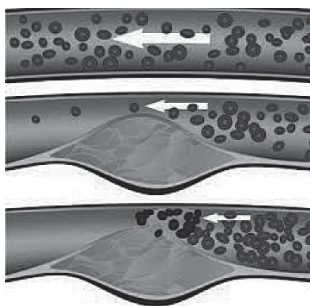
### **1.2.1 Atherosclerosis**

Worldwide, coronary artery disease (CAD) is the most frequent cause of death. Over seven million people die from CAD every year, accounting for 12.8% of all deaths. Every sixth man and every seventh woman in Europe will die from myocardial infarction [1, p. 733].

ACS refers to any group of clinical signs or symptoms that allow suspected acute myocardial infarction (MI) or unstable angina (UA). With ACS, the likelihood of developing myocardial infarction with all its consequences (arrhythmias, heart failure) increases, and the high death rate of patients remains significant [2, p. 825].

It is considered that the cause of IHD is atherosclerosis of the heart vessels. The most significant complications of the atherosclerotic process are:

1. A hemodynamically significant narrowing of the artery lumen due to an atherosclerotic plaque protruding into the lumen of the artery (Fig. 1).
2. Destruction of the fibrous capsule, its ulceration, platelet aggregation and the genesis of a parietal thrombus (Fig. 1).
3. The rupture of the fibrous capsule of the atherosclerotic plaque and the loss of the contents of the detritus lipid core into the lumen of the vessel. The detritus lipid core can become a source of embolism or the formation of a parietal thrombus.
4. Hemorrhage into the plaque from newly formed microvessels. It also can contribute to the rupture of plaque cover and the formation of a thrombus on the surface of the atherosclerotic plaque.
5. The deposition of calcium salts in atheromatous masses, interstitial substance and fibrous tissue, it significantly increase the density of atherosclerotic plaque [3, p. 13].



**Fig. 1.** Atherosclerotic plaque

### 1.2.2 Percutaneous coronary interventions

The fight against IHD is very active now. The goal is to save the lives of patients. Progress in this field is associated with the development of high-tech medical care in acute coronary syndrome in the form of percutaneous coronary interventions (PCI) (Fig. 2) [4, p. 1598].

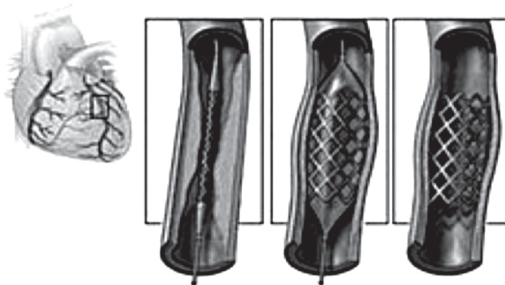
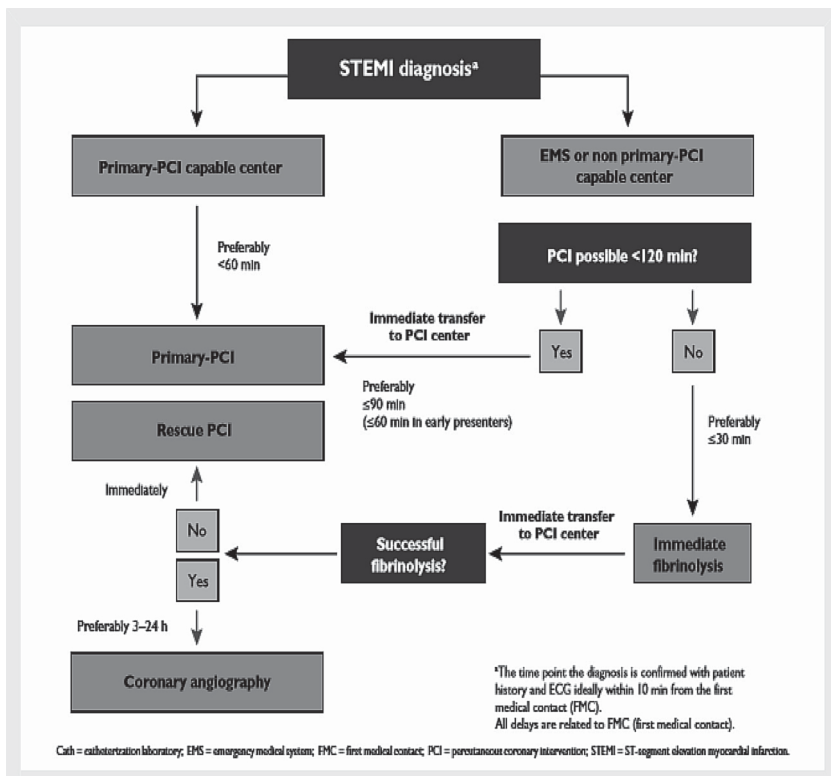


Fig. 2. PCI

Types of PCI:

- Primary PCI is defined as an emergent percutaneous catheter intervention in the setting of ACS, without previous fibrinolytic treatment. Lower mortality rates among patients undergoing primary PCI are observed in centres with a high volume of PCI procedures. Primary PCI is effective in securing and maintaining coronary artery patency and avoids some of the bleeding risks of fibrinolysis [5, p. 19]; [6, p. 13]; [7, p. 2686];
- Rescue PCI is an intervention performed in a symptom-responsive artery that remains occluded after the administration of thrombolytic agents. In settings where primary PCI cannot be performed within 120 min of FMC by an experienced team, fibrinolysis should be considered, particularly if it can be given pre-hospital (e.g. in the ambulance) and within the first 120 min of symptom onset [8, p. 2512]; [9, p. 429]; [10, p. 2851]. It should be followed by consideration of rescue PCI or routine angiography [11, p. 94].
- Prepared (“facilitated”) PCI is a planned intervention within 12 hours of the development of symptoms of MI, occurring shortly after the use of fibrinolytic agents and / or platelet IIb / IIIa receptor blockers [12, p. 156].

The logistics algorithm for acute myocardial infarction is represented in Figure 3.



**Fig. 3.** Prehospital and in-hospital management and reperfusion strategies within 24 h of FMC (adapted from Wijns et al.) [13, p. 2501]; [19, p. 15].

### 1.2.3. Lipid peroxidation

At the same time, the complex problem of atherosclerosis cannot be reduced to the level of cholesterol and lipoproteins in the blood. In recent years, the literature discusses the role of lipid peroxidation (LPO) in the etiology and pathogenesis of atherosclerosis.

Indeed, the membranes of cells and subcellular organelles, as well as blood plasma lipoproteins contain phospholipids. There are polyunsaturated fatty acids (PUFAs) are localized in the b-position of phospholipids. PUFAs are readily subjected to free radical peroxide oxidation in the presence of oxygen with formation of corresponding lipid peroxides [14, p. 1413]; [15, p. 305]; [16, p. 299].

Active forms of oxygen damage the structure of DNA, proteins and various membrane structures of cells [17, p. 127]. As a result of the appearance of hydrophilic zones in the hydrophobic layer due to the formation of hydroperoxides of fatty acids water, sodium, calcium ions can penetrate into the cells, which leads to the swelling of cells, organelles and their destruction [18, p. 257]; [19, p. 340]. Peroxide oxidation is also activated in tissues that underwent first ischemia and then reoxygenation, which occurs in spasm of the coronary arteries and their subsequent expansion [9, p. 429].

## **2. Materials and Methods**

### ***2.1. The aim***

The aim of the study is to evaluate the results of myocardial revascularization in acute coronary syndrome.

### ***2.2 Research objectives***

The research objectives are: 1) to see the time of PCI; 2) to consider the structure of ACS; 3) to study the age of patients; 4) to study the kinds of the lesion of the coronary arteries; 4) to study the parameters of echocardiography.

### ***2.3. Hypothesis***

Hypothesis. Early revascularization in the first minutes of ACS does not always have a positive effect on the myocardium, the contractile function of the myocardium decreases.

***2.4. Inclusion criteria:*** the presence of ACS, the absence of previously transferred coronary artery bypass grafting (CABG) or stenting of the coronary arteries (CA).

***2.5. Exclusion criteria:*** previous CABG or CA stenting, active tuberculosis, prisoners, incompetent persons.

### ***2.6. Process of the study***

We studied retrospectively 155 case histories of patients who entered the Republican Clinical Diagnostic Center in 2015 with the diagnosis of acute coronary syndrome (ACS) for percutaneous coronary intervention (PCI) and treated in the department of acute myocardial infarction No.1. The data was analyzed using the Microsoft Excel program.

All patients underwent PCI. These patients have a stent in the coronary artery. Patients were admitted to the control echocardiography 1.8–2 years after PCI.

### 3. Results

With unstable angina was received 22 patients, with acute myocardial infarction-133 patients.

Age averaged 59 years  $\pm$  10.62 (min-34 years, max-88 years, mode-66 years). The body mass index (BMI) is on average-27.02  $\pm$  2.87 (mode-25.71).

The time from the onset of pain to the “balloon” in 32 patients was 1–6 hours, 11 patients-6–12 hours, 112 patients-more than 12 hours.

In 77% of patients, pathological wave Q / QS was formed.

Thrombolytic therapy was performed in 27% of cases at the prehospital stage.

Lesion of the left main coronary artery was in 42 patients (stenoses within 15–80%), in 14 patients (9%) stenoses reached 50–80%.

Stenoses of more than 75% in the proximal segment of the anterior interventricular artery was identified in 64 patients (41%), in the middle section – in 61 patients (39%), in the distal segment – in 17 patients (11%).

Stenoses of more than 75% in the proximal segment of the left circumflex coronary artery was identified in 28 patients (38%), in the middle section – in 13 patients (18%), in the distal segment – in 32 patients (44%).

Stenoses of more than 75% in the proximal segment of the right coronary artery was identified in 26 patients (25%), in the middle section – in 59 patients (58%), in the distal segment – in 17 patients (17%).

All patients underwent stenting of the infarct-dependent coronary artery. The protocols of echocardiography are analyzed. The left ventricle ejection fraction (LVEF) averaged 55.98  $\pm$  7.81% (min-28%, max-73%), the final diastolic volume of the left ventricle (LV) was 139.82  $\pm$  29.33 ml (min-74 ml, max-313 ml).

Interrelationships were revealed (Pirson coefficient):

- a direct statistically significant relationship between the time from onset of the disease to the “balloon” and the left ventricle ejection fraction ( $r = 0.3$ ,  $p < 0.05$ );
- a direct statistically significant relationship between the time from onset of the disease to the “balloon” and the number of zones with regional wall-motion abnormalities of the LV ( $r = -0.18$ ,  $p < 0.05$ );
- inverse correlative statistically significant relationship between lesion of the left main coronary artery and LVEF ( $r = -0.16$ ,  $p < 0.05$ );

- a direct correlation statistically significant relationship between the body mass index and lesion of the left main coronary artery ( $r = 0.24$ ,  $p < 0.05$ ).

Identified by the Spearman rank correlation coefficient:

- a inverse statistically significant relationship between the time from onset of the disease to the “balloon” and the left ventricle ejection fraction after 1.8-2 years from PCI ( $r_s = -0.331$ ,  $p < 0.01$ );
- a inverse statistically significant relationship between the time from onset of the disease to the “balloon” and the left ventricle end-diastolic volume after 1.8-2 years from PCI ( $r_s = -0.17$ ,  $p < 0.05$ );
- a inverse statistically significant relationship between the time from onset of the disease to the “balloon” and the right ventricle end-diastolic volume after 1.8–2 years from PCI ( $r_s = -0.583$ ,  $p < 0.01$ ).

#### 4. Discussion

An overwhelming number of patients were admitted to the PCI laboratory at 12 hours or more from the onset of symptoms. Basically, there is a rescue or prepared PCI. In 77% of patients, the pathological wave Q / QS was formed at the time of admission. The left ventricle ejection fraction was higher and the number of nonfunctional zones of myocardium was lower in patients who had undergone PCI later. The echocardiography results are improving with an increase of the time from onset of the disease to PCI. Patients with a longer pain-balloon time had a lower end-diastolic LV volume, a smaller right ventricular cavity in the diastole, a smaller LV ejection fraction due to reduced end-diastolic LV volume and a hypo / akinesia zone after 1.8–2 years from PCI.

#### 5. Conclusions

The formation of a thrombus leads to the occlusion of the lumen of the vessel and the development of ischemia in the corresponding part of the myocardium (tissue hypoxia). If rapid medical measures are taken to destroy the thrombus, oxygen supply (reoxygenation) is restored in the tissue. It is shown that at the time of reoxygenation the formation of reactive oxygen species sharply increases and can damage the cell. Thus, despite the rapid restoration of blood circulation cells are damaged at the corresponding site of the myocardium by the activation of peroxidation.

#### 6. Recommendations

This article can be useful for cardiologists, intervention surgeons, therapists, medical students, interns, postgraduate students.



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